No. 81 BULLETIN REVISED JUNE, 1948
OF THE
THE AGRICULTURAL EXTENSION SERVICE, THE OHIO STATE UNIVERSITY

WHEAT GROWING IN OHIO

A modern wheat harvesting scene in Ohio.

By

EARL JONES AND C. L. LAMB

THE OHIO STATE UNIVERSITY AND THE U. S. DEPARTMENT OF AGRICULTURE, COOPERATING
AGRICULTURAL EXTENSION SERVICE, H. C. RAMSOWER, *Director,* Columbus, Ohio
Printed and distributed in furtherance of Acts of May 8 and June 30, 1914

Wheat Growing In Ohio*

By
EARL JONES, Extension Agronomist, The Ohio State University
and
C. L. LAMB, Associate Agronomist, Ohio Agricultural Experiment Station

Wheat has been an important crop in Ohio since white men started cultivating the land. About 15 per cent of the crop is fed on the farm and the remainder is sold. The trend of acreage and yields in the present century is given in the accompanying table:

TREND OF WHEAT ACREAGE AND YIELDS IN OHIO

	Average acreage	Average yield per acre (bu.)
1900–09	1,977,248	14.6
1910–19	2,083,600	17.5
1920–29	1,787,300	16.4
1930–39	2,029,000	20.7
1940–44	1,923,000	21.4
1945	1,783,800	27.0
1946	1,831,000	26.5
1947	2,186,000	22.5

Less wheat is grown in the northern part of the state, on the heavy soil areas where winter killing is more serious, than elsewhere.

Since much of Ohio's wheat now follows corn and soybeans, the acreage is likely to vary from year to year. The fall weather may not be favorable for the prompt harvesting of corn and soybeans so that wheat can be seeded. Late seeding is likely to be more frequent than in the past.

Winter vs. Spring Grains.—Wheat and other winter grains have an advantage over spring grains as they provide a winter cover crop on land that otherwise would be bare, and if they make a good fall growth, reduce the losses from erosion and leaching that might occur during the winter. In general, fall-sown varieties will produce more than the spring varieties of any grain, if conditions are favorable for winter survival.

Causes of Low Yields.—Farm management records indicate there can be little or no profit in growing wheat if the average yield over a period of years is less than 20 bushels per acre. When low yields are obtained year after year, the limiting factor must be located and corrected. If this cannot be done, the substitution of some other crop for wheat should be considered.

The main causes of low yields are: poor drainage; loss of topsoil, because of erosion; low productivity, due to the lack of a good soils program, inadequate fertilization, late seeding, winter killing; and losses due to insects, diseases, and weeds.

* That portion of this bulletin on insects was contributed by T. H. Parks, extension entomologist; that on diseases by T. H. King, extension plant pathologist; that on the combined harvester-thresher by S. G. Huber, extension agricultural engineer.

Soils and Cultural Factors

Best Soil for Wheat.—An ideal wheat soil is a loam, silt loam, or clay loam that is well drained and has been kept productive. Poorly drained soils are not satisfactory for wheat. On well drained soils, good yields can be obtained over a period of years, when adequate applications of lime and fertilizers are made in a good rotation in which clover, alfalfa or sweetclover are grown regularly, with erosion control practices as needed.

Seedbed Preparation.—An ideal seedbed for wheat is reasonably mellow at the surface and compact below. Do not overwork the soil, as there is no advantage in making a very fine seedbed. A few clods on the surface will do no harm. When wheat follows cultivated crops like corn, potatoes, soybeans or tobacco, a satisfactory seedbed may be made with a disk harrow, if the soil is reasonably mellow. Crop residues and weeds chopped up in the surface will help protect the soil during the winter.

When wheat follows oats, early plowing (as soon as possible after oats harvest) is advisable. Early disking is advisable, if plowing must be delayed. Disking may be substituted for plowing if the vegetation can be killed by disking. In dry seasons disking seems superior. Plowing will control volunteer oats better than disking.

Plant Plump, Clean Seed.—No farmer can afford to sow anything but clean, plump kernels. The fanning mill must be used vigorously to get out the shriveled grains, weed seeds, chaff, pieces of straw, and other foreign material. Some of the shriveled grains may be infected with wheat scab. Collections of seed wheat from farmers' drills show that many farmers do not clean seed properly before planting.

Time of Seeding.—Through a period of years, the time to sow is governed by the safe seeding date for the control of Hessian fly. (See Fig. 3). This is discussed under Wheat Insects. (See Page 12). In Ohio, the safe-sowing date and optimum date for seeding, as shown in yield comparisons at the Experiment Station, are the same. Seeding should not be delayed longer than necessary after the safe-seeding date, since the losses due to late seeding are large. Where conditions are somewhat unfavorable (unproductive or poorly drained soils), late seeding is more serious than on other soils. Seeding on time is especially important in the extreme northeastern part of Ohio.

Early Growth on Sloping Land Lessens Erosion.—It is essential that a good early growth of wheat be obtained on sloping land, because it offers more protection against erosion than a thin or small growth. Seeding on time, the use of the heavier recommended applications of fertilizers, and an application of manure, as soon as possible after wheat seeding, are important. Wheat should be seeded on the contour.

Rate and Method of Seeding.—Rate-of-seeding tests have been conducted for 28 years by the Ohio Experiment Station at Wooster. Eight pecks per acre has, on the average, been the most profitable rate, but seedings of 6 to 7

pecks per acre have been only slightly inferior. The heavier rate suggested should be used with late seeding and where winter killing is likely to be a problem.

The seed should be covered with 1 to 3 inches of soil. Experiments show no advantage in bringing the drill rows closer than 7 to 8 inches, the usual distance between the disks or hoes of ordinary grain drills. Wider rows have shown no advantage over the 7- to 8-inch spacings.

Adequate Wheat Fertilization Profitable.—Of the common field crops, wheat gives the greatest response to fertilizers, and the clover and alfalfa seeded with wheat give the next greatest response. The increases in the hay crop alone often pay for the fertilizer used on the wheat.

Four hundred to five hundred pounds per acre are recommended when a meadow seeding is made with the wheat. This may be reduced one-third when a seeding is not made. Grades containing only phosphoric acid and potash are recommended on highly productive land where lodging is likely to occur and when wheat is sown on or immediately following the safe-sowing date. Fertilizer containing nitrogen is recommended on land where the wheat is not apt to lodge or where the seeding is delayed following soybeans or corn. The following are satisfactory grades:

Productive soils.....0-20-10 or 0-12-12
Less productive soils.....4-12-8, 3-12-12 or 4-16-8
Sandy, muck and peat soils.....3-9-18

Smaller applications may be adequate when wheat follows liberally fertilized crops, like potatoes, tobacco, etc. The heaviest rate will be profitable when wheat follows soybeans or corn. Fertilizer applications should average 200 pounds or more per acre for each year of the rotation.

Spring Top-Dressing with Nitrogen Fertilizers.—The use of nitrogen fertilizers on wheat in the spring is often profitable. Nitrate nitrogen is produced in the soil in quantity only during the warmer months, and the soil supply may be very low in the early spring. On soils of average productivity or less, wheat may not, in the spring, produce sufficient vegetative growth to insure a satisfactory yield. Demonstrations and experiments indicate that, under the conditions just outlined, a spring top-dressing with readily available nitrogen results in an average increase of 6 to 8 bushels per acre, but in good wheat years decreases have resulted. This application is advisable on soils, of average or below average productivity, with a good stand of wheat following a fall and winter when the rainfall is above normal.

An application of 20 to 30 pounds of nitrogen per acre, April 1 to 15, is recommended where nitrogen is clearly deficient. Twenty-five pounds of nitrogen may be supplied by an application of 125 pounds of sulphate of ammonia, 160 pounds of nitrate of soda, 80 pounds of ammonium nitrate, or the equivalent amount of other carriers. These fertilizers should be spread broadcast when the wheat plants are dry.

There are important limitations to this practice, since it may do more harm than good. When the wheat is making more than normal growth, an excessive straw growth of the wheat may damage both the wheat and the new seedings, even though no lodging occurs. (See Lodging, page 9.)

Manure Top-Dressings.—Light top-dressings of manure on wheat during the fall and winter very noticeably improve the new seeding made in the wheat on slopes and light colored soils, especially if average or below in productivity. Wheat yields on the less productive soils may be increased by the manure top-dressing, but little or no increase may be expected on productive soils. The slopes and the less productive areas should be covered early in the fall. All other light-colored soils should be covered later as conditions permit, even though the clover and alfalfa are seeded before the manuring is completed. Four to eight loads per acre are recommended. If a manure spreader is not available, the manure should be spread as lightly and uniformly as possible.

The mulching effect of the manure is probably responsible for most of the benefit to the new seeding. The mulch reduces the losses due to heaving, conserves moisture in the spring, provides some coverage for the clover and alfalfa seed, protects the young plants from drying out, and to some extent keeps the surface layer of soil from becoming hard and compact. Manure also supplies plant nutrients. Straw, old hay, clover chaff, etc. (not over 2 tons per acre), spread uniformly, may be used as a mulch, but nitrogen fertilizers may also be necessary.

Climate Determines Type of Wheat Grown

Hard and Soft Wheat Areas.—Soft wheats are grown in the eastern part of the United States where the rainfall is greater than in the central part of the country. Hard wheats are grown most extensively from Texas to the Dakotas where the rainfall is less than in the eastern section. When wheat varieties are moved out of their adapted areas, they lose their desirable milling qualities. Hard red winter varieties are not satisfactory in Ohio.

Soft Red Winter Wheat Best for Ohio.—Ohio is in the soft red winter wheat region. Although used to some extent for blending with hard wheat flour, soft red winter wheat flour is most widely used for crackers, cakes, pastries, and breakfast foods. There is a definite market for soft wheat flour, and the area in which soft wheat is grown cannot be largely expanded due to climatic limitations. The requirements for flours to be used for these products are very exacting.

The Federal Soft Wheat Laboratory, at the Ohio Agricultural Experiment Station, is developing standards for judging the value of soft wheat flour and is studying the influence of climate, soils, and other factors on its quality.

Varieties of Wheat

Progress in developing new varieties of wheat may seem slow, because it is difficult to find new superior strains, and it takes time to test them adequately. However, a new wheat with a yielding ability of 1 to 2 bushels per acre more than the old varieties, or with superior quality, better resistance to lodging, greater winter-hardiness, or improved resistance to disease or insect pests, is very important. These advantages are secured by the farmer at practically no cost. The development of resistant varieties is the only satisfactory method of controlling certain diseases.

The Ohio Experiment Station has developed valuable varieties of wheat —Trumbull and Fulhio—from single plant selections made in old standard

FIG. 1. Wheat nursery at Ohio Experiment Station, at Wooster.

varieties. More recently, a hybridization program has been adopted, and many thousands of selections from these populations have been tested.

Thorne, a brown-chaffed, beardless wheat selected from the cross Portage x Fulcaster, was introduced in 1937. In 1948, seed of Butler wheat, selected from the cross OSU 101-3 (Portage x Fulcaster) x Trumbull became available. Butler is white-chaffed and bearded. Other promising lines are now being extensively tested and new varieties may be expected from time to time.

Recommended varieties are Thorne, Trumbull, Butler, and Fulhio. Vigo, a new Indiana variety, might also be considered but it has not been sufficiently tested in Ohio.

In southwestern Ohio, where scab may be severe, Trumbull or Butler are to be preferred since they are least affected by the disease. Butler is more winter-hardy; Thorne may be damaged most where the productivity level is low or planting is delayed. Vigo is reported winter-hardy in Indiana.

Thorne and Butler have excellent straw and are good wheats for combine harvesting. Vigo is fairly good. Trumbull has medium stiff straw, but distinctly weaker than Thorne or Butler. Fulhio has somewhat weaker straw than Trumbull.

In 76 tests in the past 7 years, Butler has averaged almost 1 bushel more than Thorne and in the past Thorne has yielded more than any other named variety. Thorne commonly has low weight per bushel, and may not grade well. Where Thorne produces a satisfactory crop it is probably the best variety. Butler and Trumbull are better where scab may be severe.

Varieties which will not produce satisfactory soft wheat flour should not be grown. The Ohio crop has an enviable reputation as high quality soft wheat, and a premium has frequently been paid in the open market on this basis for Ohio flour. Any appreciable acreage of Michikof, Turkey, Kawvale or other hard red winter varieties, such as Pawnee, would result in loss of this premium and consequent loss to the farmer.

Varietal Mixtures.—Wheat may become mixed when several varieties are grown in a community. Most of the mixtures are brought to the farm at harvest time. The combine should be cleaned out before it is moved from one farm to another. This can be accomplished by opening the clean-outs at the lower end of the tailings and grain elevators and then running the machine for several minutes. The grain tank also should be thoroughly cleaned. In spite of these precautions, some grain will remain in the machine. The first 25 to 50 bushels which come from the combine or thresher should not be used for seed. All bags should be cleaned. Cross pollination between neighboring wheat plants is negligible.

Certified Seed Wheat

To provide for the increase of superior new varieties of wheat and for the maintenance of supplies of clean, pure seed of recommended varieties, the Ohio Seed Improvement Association, in cooperation with the Agricultural Extension Service, provides a system of field and sample inspections of wheat grown for seed purposes. Representative samples of the seed from those fields which pass a rigid inspection, as to varietal purity, presence of other crops, troublesome weeds, and diseases, are examined carefully for seed quality and for germination.

Only those lots of seed which satisfactorily meet the requirements of this association of growers and seed distributors may be sold as certified seed.

Foundation Seed Wheat.—Foundation seed wheat is of the highest quality as regards varietal purity. It must be 99.8 per cent pure as to variety. This seed should, if available, be planted by new growers who desire to produce certified seed.

Certified Seed Wheat.—Certified seed wheat must be 99.5 per cent pure as to variety, and must be practically free from noxious weeds, rye and smut. The farmer who desires good clean seed wheat, but is not planning to

produce inspected seed for sale, may well sow certified seed wheat. Fields planted with certified seed are eligible for inspection but seed growers should periodically return to foundation seed when it is available.

Winter Killing

Four main factors may bring about winter killing: (1) heaving; (2) smothering with ice; (3) exposure to cold drying winds in the spring; and (4) direct effect of low temperatures. The first two factors are responsible for most of the winter or spring killing in Ohio. The wheat plants are partially heaved out by the action of frost and the plants and exposed roots are then dried out by winds.

There is considerably more winter killing in the poorly drained soil areas than in other sections of the state. Late seeding and other unfavorable conditions increase the loss. Damage can be partially relieved by better drainage and more liberal fertilization, but cannot be entirely avoided. Many western Ohio and northwestern Ohio soils occupy level areas and are rather heavy. Water may accumulate in the upper surface of the soil in the late winter and early spring even though the fields are tile drained. The wheat plants heave during freezing weather and the drying winds then ruin the prospects for a good crop. Applications of manure as recommended on Page 6 tend to reduce the losses due to winterkilling.

Lodging

A combination of favorable growing conditions and a productive soil with large supplies of available nitrogen may result in so much straw growth that the wheat lodges, reducing grain quality and yields and damaging the new seeding. The new seeding is often harmed by a heavy straw growth, even when no lodging occurs.

If wheat is making such a rank growth that lodging is likely to occur later, it may well be pastured 10 or 15 days during the last half of April. Where the wheat cannot be pastured, clipping with the mowing machine just before the jointing stage will produce the same effect as pasturing. The clipping should be done before there is any chance of cutting off the wheat heads but late enough so that a considerable amount of the leaves is cut off. The best stage for clipping does not last more than 5 days and usually occurs the last half of April. The cutter bar should be set as high as possible—4 to 5 inches. The height of the wheat heads can be determined by splitting several stems. If many heads are removed in the clipping, yields will be seriously reduced.

If mowing or pasturing prevents lodging, the yield of wheat may be slightly increased, but usually these practices result in a decrease of 3 to 6 bushels or even more per acre although with benefit to the new seeding.

Applications of straw, as suggested on Page 6, reduce the growth of wheat and therefore lessen the probability of lodging.

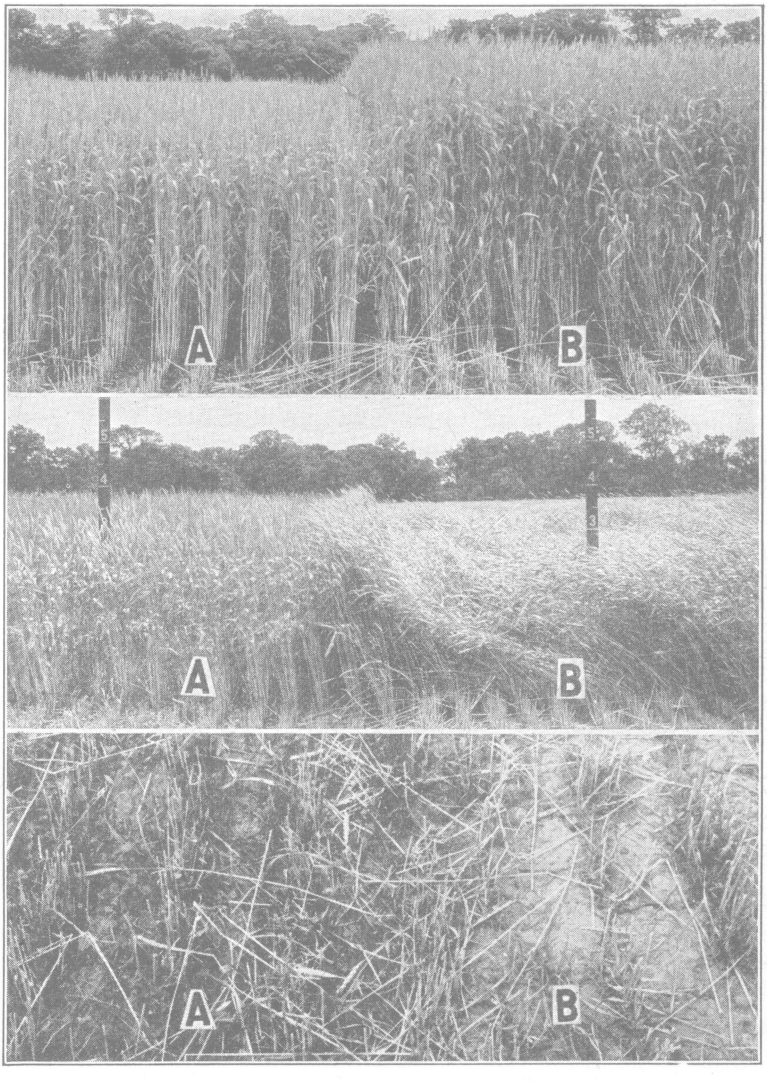

FIG. 2. Clipping wheat to control lodging and save stand of legumes. Top, left—Wheat clipped 4 inches high, May 1. Right—Unclipped. Center—Appearance on June 12. Bottom—Good stand of legumes where wheat was clipped.

Harvesting

Experimental data indicate that yields are reduced when wheat is harvested too early. There is no scientific foundation for the belief that grain will fill after cutting. Experimental work indicates that maximum yields are reached 2 to 4 days before wheat is dead ripe (14 per cent moisture in the kernels).

Shocking After the Binder.—There are losses every year because wheat is not properly shocked. The first two sheaves of each shock should be set up so they stand firmly together. The remaining sheaves should be jammed into the stubble to insure firmness and then leaned inward. Each sheaf should be firmly put in place and the shock capped with two broken sheaves.

The Combine.—The combine is fast becoming the universal machine for the harvesting of small grains. Machines, made in 3½-, 5-, 6-, and 7-foot sizes, have generally replaced the original larger outfits in Ohio. Many combines receive their power from the tractor engine through the power take-off. However, many are now equipped with an individual engine to furnish a more steady and even flow of power.

These small machines are usually equipped with a cylinder nearly equal in width to the width of the cutterbar, and of such type that the straw is broken up as little as possible. This makes for more efficient separation, especially if green material becomes troublesome.

The most recent development is the self-propelled combine. These machines are made in widths varying from 7 to 14 feet. No grain is knocked down when opening up a field with this type machine. The investment is fairly large and a considerable acreage must be harvested each season for economical operation.

Satisfactory Operation of Combine.—The following factors govern the efficiency of combine operations: (1) The machine must be adjusted and operated correctly; (2) the grain must be standing, and be comparatively free from weeds and other green growth; (3) the wheat must be dead ripe and the moisture content of the grain should be less than 14 per cent, preferably 12 to 13 per cent. (Many local elevators are equipped to make moisture tests and their assistance is helpful in deciding when wheat can be satisfactorily harvested with a combine.) It is especially important that the grain be free from green material and excess moisture.

Under favorable conditions wheat can be combined with a loss of not over 1 to 4 per cent of the total yield. With the binder-thresher the loss is approximately 6 to 8 per cent. Under unfavorable conditions the loss with a combine may run as high as 18 to 20 per cent. The factors which are likely to increase the loss are: (1) improper adjustment of the machine, (2) overloading the machine, and (3) tangled weedy grain. Since the crop is left standing in the field longer than is the case when a binder is used, there is some risk of loss from heavy storms.

Operating Combines in Ohio.—Weather conditions in Ohio are not as satisfactory for the use of a combine as they are in some of the western states. These disadvantages are more apparent with oats and barley than with wheat. A combine does make the farmer independent of extra help and meals, and allows him to proceed with his work without waiting for a threshing machine.

With weedy or lodged and tangled grain the crop can be placed in windrows with a windrower, allowed to cure from 2 to 5 days, and then threshed by the combine with the use of the pick-up attachment. This requires extra equipment and means increased expense. The windrows are left on a rather high stubble to facilitate drying. Grain threshed from the windrow is usually of good quality.

Treatment of Wheat Stubble to Avoid Injury to New Seeding

When wheat is combined and the straw is left on the stubble, the new seeding is seriously damaged, especially if the yield of wheat is average or higher. The following recommendations are made:

Combine Harvest

(1) For farms where bedding is needed, cut combined stubble at normal hay height as soon as combining is completed; remove all straw and stubble for bedding. If less bedding than this will make is required, remove the loose combined straw and delay clipping the field until mid- or late August.

(2) For grain farms: (a) Cut the stubble just after harvest and remove everything; or (b) Remove the loose combined straw with later mowing; or (c) Cut the stubble just after harvesting and leave everything on the ground.

When the field is mowed soon after combine harvest (July), a second mowing or pasturing before September 1 is recommended if the new seeding makes a large growth.

If the potash and phosphate which are removed are returned, there can be no objection to selling straw which, if left untouched after combining, seriously endangers the important soil-building crops. The organic matter produced when straw is removed for the benefit of the seeding will be greater than would be the case if the untouched straw seriously injured the new seeding.

Binder Harvest.—Mow at normal hay height August 15 to September 1. Remove growth if it can be profitably utilized.

Pasturing.—The new seedings may be pastured after wheat harvest, but the livestock should be removed before all growth is completely eaten down. Grazing after September 1 may seriously injure the new seeding.

Important Wheat Insects

Hessian Fly.—The Hessian fly is probably the most destructive wheat insect in Ohio. There are two generations annually. The larvae of the fall generation feed on the stem of the young plant beneath the leaf sheath and frequently destroy it. Those of the spring generation feed on the side of the green stem usually just above the lower joints. This frequently causes the

ripening straw to break over, thus reducing the yield and making harvesting difficult.

The adults, which resemble mosquitoes, emerge in late April and May and again in September and early October. Eggs are deposited on the wheat leaves. The newly hatched larvae make their way down beneath the leaf sheath to the tender stem. This insect passes the winter and summer as a full-grown larva within a tough brown covering known as the "flaxseed." These are found on the plant at the point where the larvae feed.

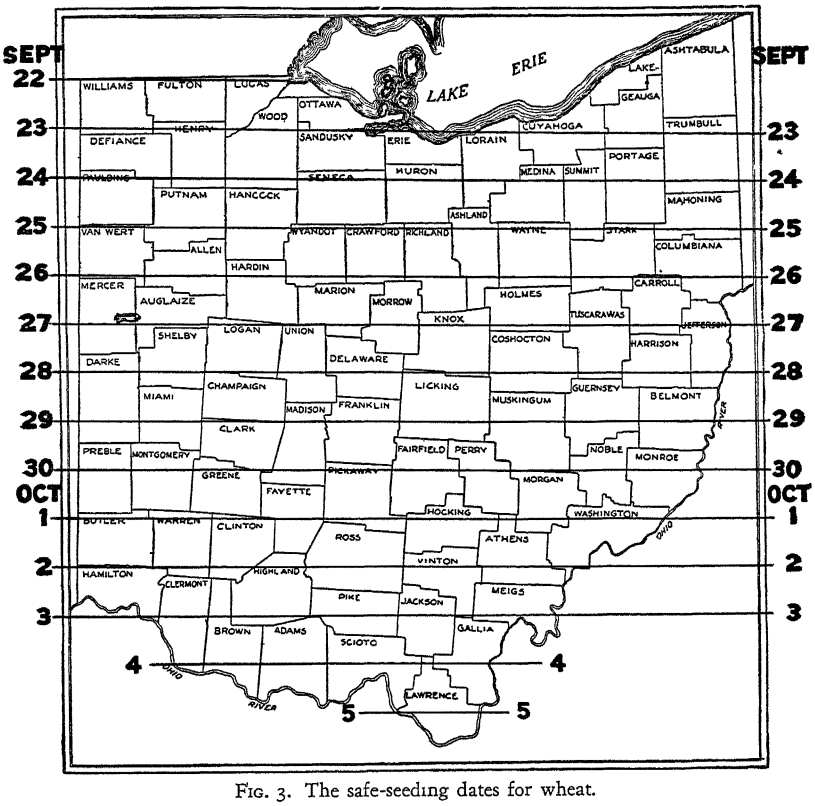

FIG. 3. The safe-seeding dates for wheat.

Adults of the fall generation lay their eggs on early sown or volunteer wheat, which may be seriously infested before winter. Numerous observations have shown that the early seeded wheat suffers the most damage and at the same time builds up a fly population sufficient to cause a general infestation of all wheat in the community the next spring.

Hessian fly outbreaks are irregular. The insect is very sensitive to moisture conditions, being favored by rainy seasons. They may become very abundant, if the weather is favorable and early sown or volunteer wheat is plentiful. Such outbreaks are sometimes brought under control suddenly by adverse weather conditions, principally by periods of drouth during the

spring and fall. Insect parasites frequently help in reducing the numbers of the insect during the summer. Regardless of natural agencies, control practices must be used on the farm, if serious losses are to be prevented.

Control.—Delayed seeding, so that the adults of the fall generation have disappeared before the young wheat comes above ground, is the only practical method of control in Ohio (Fig. 3). This practice is essential in years when the insect is increasing rapidly in numbers. This does not mean late seeding, as is sometimes inferred, but the postponement of all wheat seeding until the recognized safe seeding dates. These dates are not fly-free all years, but fall infestation occurred in wheat sowed after these dates in only five of the 30 years the insect has been observed in Ohio. In only one of these five years was the infestation serious.

Many farmers have questioned the advisability of delaying seeding when there is little Hessian fly present in a community. In most sections of the state, the safe seeding dates are early enough for wheat seeding and, on well drained and well fertilized soil, result in the maximum yield regardless of Hessian fly. These dates do not vary from year to year and should be followed every season.

Chinch Bug.—The chinch bug sometimes damages the wheat crop. This insect is especially numerous during periods of two or three consecutive dry years. It works, both in the young and adult stages, at the base of the plant and does its damage by piercing the epidermis and sucking the sap. It does little damage to wheat in Ohio, except during periods of severe infestation which, fortunately, are infrequent.

Control.—Thin stands of wheat are most likely to build up a population of chinch bugs in May and June. Soil, well shaded by a good stand of wheat, is unsuited for raising a brood of young bugs. The insects concentrate in the so-called "thin spots" where the soil is not shaded. A full seeding and fertilization tend to thicken the stand and discourage chinch bugs. Top-dressing wheat in winter with straw has been observed to promote infestation in those parts of the field where straw has been spread.

There is no chance to protect winter wheat by means of chemical barrier lines, such as are used for protecting corn.

Wheat Jointworm.—The wheat jointworm is a small larva which lives in cells in the stems of wheat. The presence of the insect is brought to the attention of the farmer when he finds short, thickened, woody pieces of straw in the threshed wheat.

The jointworm causes some bending over of the straw at the point of infestation. Because of this, heads on infested straws are cut off by the harvester and left in the field. Upright infested stalks are not as productive as normal stalks, but the reductions in yield are due mainly to lodging. Fortunately, outbreaks of jointworm are rare. Usually it is held in check by parasites. With our present rotations, no effective methods of control are

known, since the stubble and straw left in the field must be plowed under or burned to destroy the larvae.

Wheat Midge or Red Weevil.—This insect is a small maggot which feeds on the wheat kernels when they are in the milk or soft dough stage. Under heavy infestations many kernels are either deformed or are so badly shriveled by the maggots they are blown out with the straw and lost. The eggs are deposited in the immature heads of wheat by very small flies, called "midges." The eggs hatch into tiny red maggots, which feed on the soft kernels. When mature, the larvae drop to the ground and bury themselves in the soil, where they pass the winter. There is no practical method of control with our present crop rotations. The wheat midge is not related to the weevils that infest grain in bins.

The Black Wheat Stem Sawfly.—The black stem sawfly was for a period of years a serious wheat pest in eastern Ohio. It was found in Columbiana County in 1934. During the following 7 or 8 years it caused serious losses to wheat, just previous to harvest, in Mahoning, Columbiana, Stark, Carroll, Tuscarawas, Jefferson and Harrison Counties. It has never become established in the western half of Ohio, and has now subsided to become a pest of minor importance in the counties named.

The adult is a four-winged fly known as a "sawfly" which, when the wheat head is forming, pierces the stem of the plant and deposits an egg in it. The yellow larva feeds on the inner wall of the stem and bores down through the nodes. It reaches the base of the stem at about the time the wheat is ripening, where it later cuts the straw near the soil surface. This causes the straws to fall within a few days of harvest and the injury is often confused with that of the Hessian fly. During years of severe damage, from 50 to 70 per cent of the straws were infested, many being cut off near the ground and lost to the harvester.

The winter is passed by the larvae in the old stubble, where later they pupate. The adults emerge in late May and June.

There is no practical control known for this insect. Earlier harvesting of the ripened straw when cut with a binder and raking up and gathering the fallen straws are recommended. This will salvage many of those infested stems which carry wheat kernels of surprisingly good quality.

Spittle Bugs.—These are small, grayish-brown, robust, jumping plant bugs—somewhat resembling over-sized leafhoppers. They perch on the green head and stem close below the head, where they feed by sucking the sap. They are yellowish-green when immature and develop in masses of spittle-like material on stems of clover and weeds. When they become full grown they abandon the mass of spittle and fly to new feeding grounds. These insects are associated with high humidity through May and June. They cause slight damage to the wheat heads, but such losses are difficult to measure. There is no practical control method known.

Granary Weevils.—There are several species of these insects and they may do enormous damage to stored grain. Injury is more likely to come to grain that is damp when stored. On farms where the grain is stored in tight bins, the use of carbon bisulfide or one of the substitute fumigants is the simplest and least expensive method. For best results the temperature of the grain should be above 65 degrees F. Carbon bisulfide is inflammable when mixed with air and must be used with caution. Directions for using this chemical can be had upon application to your county Extension agent or your College of Agriculture.

Much damage from grain weevils can be prevented if the grain bin, as soon as emptied, is sprayed with 5 per cent DDT emulsion. This kills the residue of weevils that may later give rise to a serious infestation.

Important Diseases of Wheat

Stinking Smut.—The loss caused by stinking smut usually exceeds that caused by any other wheat disease in Ohio. During the years 1931 to 1935 inclusive, estimated losses due to stinking smut have varied from 1.5 to 2 per cent. When expressed as bushels this represents a reduction in yield ranging from 517,000 to 818,000 bushels for Ohio alone. Generally, the loss for any one year exceeds a half-million bushels. Stinking smut destroys practically all the grains in the infected heads, and also reduces the market value of the entire crop because of the peculiar odor of the smut balls and spores.

When smutted wheat is planted, the spores germinate and grow along with the grain, infecting the wheat plant in the seedling stage. The fungus continues to develop in the wheat plant without showing any marked indication of its presence until heading time, when usually the entire head of wheat becomes invaded with the fungus, with smut balls developing instead of grains.

Smutted heads are easily detected before ripening. They stand erect and are blue-green in contrast to the yellowish-green cast of the healthy heads.

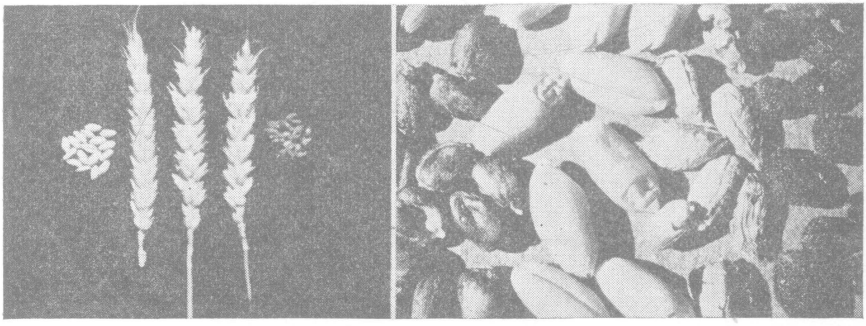

FIG. 4. Left—Wheat infected with stinking smut. Note spread of the glumes. Right—Smut balls of stinking smut as compared to healthy grain.

At harvest time, the chaffy parts of infected heads are spread out more than in healthy ones, and the kernels are shorter, plumper, and darker in color than the healthy grain.

Control.—Stinking smut can be controlled by first cleaning the seed with a fanning mill and then treating it with New Improved Ceresan dust. The dust is used at the rate of ½ ounce per bushel of seed. Or, the new Ceresan M may be used as a dust or dry seed disinfectant, or as a slurry in an approved type slurry treater. If used as a dust, ½ ounce per bushel of seed is the suggested rate; if used as a slurry, one pound or 16 ounces to one gallon of water. (See manufacturer's recommendations.) The wheat should be left in a sack or pile for at least 6 hours after treatment. Seed may be treated one to two months before sowing. Treated wheat is poisonous to livestock and should not be fed or sold as feed.

Directions for making a simple and inexpensive homemade treater (The Minnesota Seed-Grain Treater) for farm use are given in USDA Miscellaneous Publication 330. Your county agent can supply you with a copy.

Advantage can be taken of a portable seed grain cleaner and treater wherever one is available. In some communities the elevators or seedsmen have equipment available for seed treatment at a nominal cost.

Loose Smut.—Loose smut may be easily identified in the field at heading time by the black spore masses which replace the wheat heads, and at harvest time by the naked stalk tip. The chaff and kernels are usually both destroyed by the smut fungus.

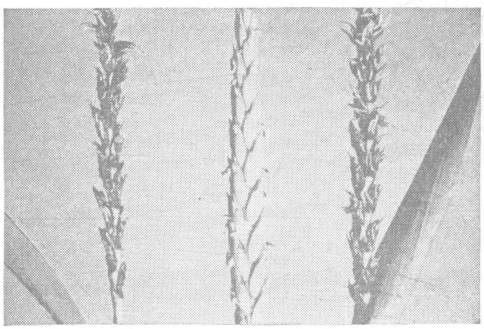

FIG. 5. Wheat heads infected with loose smut as compared to a healthy head.

Control.—Since the fungus which causes loose smut is contained within the seed coat of the wheat, Ceresan will not control this disease. The hot water method, which requires accurate temperatures and equipment not available to the average grower, must be used. Instructions will be sent on request to your county agent or the College of Agriculture.

Resistant varieties offer the most permanent control for loose smut. Trumbull wheat is practically immune from the disease, and Fulhio shows a high degree of resistance, while Thorne is slightly but probably not seriously susceptible to loose smut. Butler and Vigo appear to be satisfactorily resistant.

Wheat Scab.—Grain growers will remember that in 1946 and 1947 there

were severe scab epidemics in parts of Ohio. The wheat scab fungus also causes scab of barley, oats, and rye, and a root and ear rot of corn.

Wheat scab can be identified in the field by the appearance of white heads or parts of heads shortly after blossoming when the rest of the heads are still green. No kernels or only badly shriveled ones are produced in the affected parts. In addition to blasted heads, this fungus also causes a seedling blight of wheat which can be largely eliminated if plump clean wheat it sown. However, blasting of the heads cannot be entirely controlled by sowing clean seed, because the spores of the fungus blow from corn stubble and refuse left in the field from the previous corn crop. In Ohio where wheat is sown in corn stubble, more scab occurs than in other portions of the State. Fifty per cent infected heads have been found where wheat followed corn, while in the same field, where oats preceded wheat, only 8 per cent of the heads were affected.

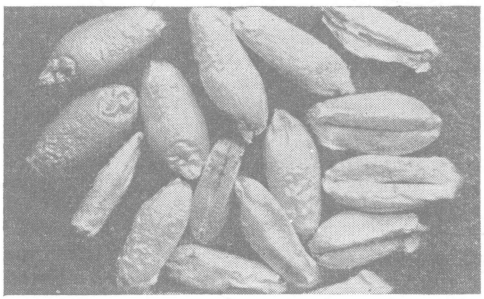

FIG. 6. Healthy and scab infected wheat kernels.

Control.—The ultimate control of this disease lies in the development of resistant varieties. No varieties are known at the present time which are either immune or highly resistant and at the same time suitable for Ohio conditions. Trumbull and Butler are probably as resistant as any varieties now available. Seed treatment helps to insure better stands, quality and yield, since it reduces seed decay and the seedling blight stage of this disease. (See recommendations for seed treatment under Stinking Smut.)

Seedling Blights.—Seedling blights are caused by a number of fungi, such as *Helminthosporium, Fusarium,* etc. which under favorable conditions may cause severe damage to the wheat crop. These diseases, which originate from scabby, shriveled and blackened seed, are not always controlled by seed treatment, but the damage caused is reduced considerably and a better stand generally results if the seed is treated. All wheat used for seed should be treated. Experimental results have indicated that New Improved Ceresan, or Ceresan M will partially control these diseases. (See seed treatment recommendations under Stinking Smut).

Stem Rust.—Stem rust is a serious factor in wheat production throughout the northwest, and in Ohio it causes loss to individual growers during some seasons. Formerly it was quite prevalent in Ohio. The common barberry is the alternate host of this rust fungus. The spores, which infect the wheat in the spring, are blown from common barberry bushes in the vicinity. On these infected wheat plants many spores are quickly produced which in turn

blow to other wheat plants, and soon the entire field develops stem rust. The red pustules that occur mainly on the stems and leaf sheaths are larger than those of leaf rust, much longer than broad, and contain a brownish-red powder. When the epidermis breaks, conspicuous fragments of it cling about the postules. This is the red rust stage.

About harvest time, the pustules become black and appear as raised, elongated spots on the surface of the wheat plant. This is the black rust stage.

Control.—If the common barberry is completely eradicated, severe epidemics of stem rust will probably disappear. However, some stem rust probably will continue to occur due to spores blown in from the south. Growers who have experienced rust epidemics or who know of common barberry bushes in their vicinity, should notify their county Extension agent, or the Extension specialist in plant pathology. The Office of Barberry Eradication will be notified and an attempt will be made to eliminate such barberry bushes.

While resistant varieties have been developed in some sections of the country, they are seldom useful in other sections because there are many different strains of the rust fungus.

Leaf Rust.—In addition to stem rust, wheat is also attacked by a leaf rust, often with considerable losses. The leaf rust fungus does not attack the barberry and this shrub has nothing to do with the spread of leaf rust.

In leaf rust, the red spore pustules are mainly on the leaf blades and, to a lesser extent, on the leaf sheaths and stems. They are about the size of a pin head, round or oval in shape, and yellowish or orange-brown in color. The wheat epidermis is not conspicuously ruptured, as in stem rust. The black spore pustules are small and flat and do not rupture the epidermis.

We have no practical control measures to suggest for left rust. Farmers should be able to distinguish between the two types of rust so they will know whether or not to look for barberry bushes when epidemics occur.